

a titanium silicide contact having a composition that is different from the layer of titanium alloy, the contact being directly coupled to the alloy layer.

REMARKS

Applicant has carefully reviewed and considered the Office Action mailed on May 31, 2002, and the references cited therewith.

Claims 46, 57, 60, 64, 68, 72, 76, 77, 80, and 81 are amended, no claims are canceled, and no claims are added; as a result, claims 46-47 and 57-82 are now pending in this application.

§102 Rejection of the Claims

Claims 60, 62-64, 66, 68, and 70 were rejected under 35 USC § 102(b) as being anticipated by Ikeda et al. (U.S. 5,239,196).

The rejection states that Ikeda shows:

an alloy layer of titanium alloy TiSi_x (cf. Column 36, lines 55-59) within a contact opening 28 (cf. Figure 9 and column 61, lines 57-59) in the insulating layer 27, the contact opening being at least partially over the active region (see Figure 9) (this aspect is inherent in MISFET devices, as it simply implies that the gate, which, as we will see, is positioned within the contact opening, is at least partially over the active region);

The rejection further states:

since TiSi_x is both a titanium alloy and titanium silicide, the final limitation of this claim is automatically met by splitting the TiSi_x gate material into two portion that are in contact with each other, and calling said portions titanium silicon alloy and titanium silicide respectively.

Ikeda appears to show a refractory metal silicide film 13B of a gate electrode coupled to a poly crystalline portion 13A of the gate electrode. Ikeda appears to include titanium silicide (TiSi_x) as a possible refractory metal silicide for the gate electrode shown. However, Ikeda does not appear to show an alloy layer of a titanium alloy **within a contact opening** in the insulating layer, the contact opening being at least partially over the active region. Applicant respectfully submits that neither a gate, nor a space that surrounds a gate is analogous with a contact or a contact opening. The gate as described by Ikeda, and most gates in general, are electrically

isolated by a gate oxide, which is in direct contradiction with a "contact."

Further, the connection hole 28 cited by the Examiner appears to be filled with an "intermediate conductive layer 29," as opposed to elements 13A or 13B as referred to in the rejection. Applicant is unable to find any mention of a material selection taught in Ikeda for the intermediate conductive layer 29. Applicant respectfully traverses the assertion from page 5, first paragraph of the pending office action that states, "an alloy layer of titanium alloy TiSi_x within a contact opening 28" is shown.

In contrast, Applicant's claim 60 includes an alloy layer of a titanium alloy within a contact opening in the insulating layer, the contact opening being at least partially over the active region

Applicant respectfully traverses the assertion that the elements of a titanium alloy layer and a titanium silicide contact are automatically met by splitting the TiSi_x gate material into two portion. However, in the interest of moving this application forward towards allowance, Applicant has made amendments to selected claims.

Ikeda appears to include a refractory metal silicide film 13B of a gate electrode, however, Ikeda does not include, teach or suggest a titanium silicide contact **having a composition that is different from the layer of titanium alloy**, the contact being directly coupled to the alloy layer.

In contrast, Applicant's claim 60 includes a titanium silicide contact having a composition that is different from the layer of titanium alloy, the contact being directly coupled to the alloy layer.

Because the Ikeda reference does not show every element of Applicant's independent claims, a 35 USC § 102(b) rejection is not supported. Reconsideration and withdrawal of the rejection is respectfully requested with respect to Applicant's independent claims 60, 64, and 68. Additionally, reconsideration and withdrawal of the rejection is respectfully requested with respect to the remaining claims that depend therefrom as depending on allowable base claims.

§103 Rejection of the Claims

Claims 67, 71-72, 74-77, and 79-81 were rejected under 35 USC § 103(a) as being unpatentable over Ikeda et al. (U.S. 5,239,196) in view of Xu et al. (U.S. 6,217,721 B1).

Applicant respectfully submits that with regard to claims 67, 71-72, 74-77, and 79-81, Xu does not cure the deficiencies of Ikeda as described above. Because the cited references, either alone or in combination, do not show every element of Applicant's independent claims, a 35 USC § 103(a) rejection is not supported by the references. Reconsideration and withdrawal of the rejection is respectfully requested with respect to Applicant's claims 67, 71-72, 74-77, and 79-81.

Claim 46 was rejected under 35 USC § 103(a) as being unpatentable over Ikeda et al. (U.S. 5,239,196).

The rejection of claim 46 (and subsequent claims) cites official notice "that metal conducts better than polysilicon." Applicant respectfully traverses such a broad assertion that all metals conduct better than polysilicon. Further, Applicant respectfully asserts that even if it is assumed true that "metal conducts better than polysilicon," there is no teaching in Ikeda that when combined with this assumption cures the deficiencies of Ikeda.

Further, Applicant again respectfully submits that, Xu does not cure the deficiencies of Ikeda as described above. Because the cited references, either alone or in combination, do not show every element of Applicant's independent claims, a 35 USC § 103(a) rejection is not supported by the references. Reconsideration and withdrawal of the rejection is respectfully requested with respect to Applicant's claim 46. Additionally, reconsideration and withdrawal of the rejection is respectfully requested with respect to the remaining claims that depend therefrom as depending on allowable base claims.

Claims 57-59 were rejected under 35 USC § 103(a) as being unpatentable over Ikeda et al. (U.S. 5,239,196) in view of Xu et al. (U.S. 6,217,721 B1).

The rejection regarding Xu states:

It is especially advantageous in the case of high aspect ratio contact holes to fill them with aluminum that subsequently forms a high conductivity alloy

(titanium-aluminum) with the titanium material of a liner of the walls (except the silicided bottom) for the purpose of increasing the electrical conductivity for reduced response time.

The rejection further states that “the method used for producing the titanium layer is irrelevant to the present device type invention.”

Xu appears to show a first sublayer 160 of pure titanium metal within a contact hole. Xu also appears to show a second sublayer 162 of a compound, such as titanium nitride. Xu also appears to show a third sublayer 164 of titanium metal. Xu appears to suggest that aluminum can be used to fill the sublayers listed above, and that the Ti and Si are silicided. However, Xu does not show a contact having a **titanium alloy** layer formed overlying walls of a contact hole and a titanium silicide layer formed overlying an exposed silicon base layer of the contact hole, the titanium silicide layer being directly coupled to the titanium alloy layer, and having a composition that is different from the titanium alloy layer.

In contrast, Applicant’s claim 57 includes a contact having a titanium alloy layer formed overlying walls of a contact hole and a titanium silicide layer formed overlying an exposed silicon base layer of the contact hole, the titanium silicide layer being directly coupled to the titanium alloy layer, and having a composition that is different from the titanium alloy layer.

Regarding claim 58, Xu does not show a **titanium alloy** layer formed overlying walls and an exposed base layer of a contact hole. Again, Xu appears to form a pure titanium layer 160.

Regarding claim 59, Applicant submits that the method limitations must be given patentable weight insofar as the method described defines a product feature of an end result that is patentable. MPEP 2113 begins by stating that, “product-by-process claims are not limited to the manipulations of the recited steps, only the structure implied by the steps.” Applicant respectfully submits that while claim 59 is not limited to the manipulations of the recited steps, the recited steps also cannot be ignored. The intent of product-by-process claims is that they define a structure implied by the steps. When the recited steps define a patentable structure implied by the steps, the method limitations must be given patentable weight.

As recited in the specification on page 2, lines 6-9, prior method such as deposition of “titanium tetrachloride, though, can only be reduced at temperatures exceeding 1000 degrees

Celsius with certain reducing agents. At these temperatures, the silicon base layer will be damaged. Therefore, there is a need for a method of forming titanium from titanium precursors at lower temperatures.”

Applicant respectfully submits that the product formed by the process described in claim 59, among other advantages, does not possess damage to a silicon base layer from high processing temperatures. The recited steps therefore define a patentable structure implied by the steps, and the method limitations must be given patentable weight.

Claims 47, 61, 65, and 69 were rejected under 35 USC § 103(a) as being unpatentable over Ikeda et al. (U.S. 5,239,196). Claims 73, 78, and 82 were rejected under 35 USC § 103(a) as being unpatentable over Ikeda et al. (U.S. 5,239,196) in view of Xu et al. (U.S. 6,217,721 B1).

The rejection states that “zinc would therefore obviously be a suitable material to provide an intermediate layer in view of its resistivity, which is about a factor 3 higher than aluminum.” Applicant traverses Examiner’s assertion that it would have been obvious to one having ordinary skill in the art to include a titanium alloy that comprises titanium and zinc as taught by Applicant’s specification. Applicant submits that the technical hurdles involved in depositing titanium and titanium alloys as described in Applicant’s background section are not addressed by merely asserting that “zinc would therefore obviously be a suitable material.”

Applicant respectfully submits that the assertion that “zinc would therefore obviously be a suitable material,” uses impermissible hindsight. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in applicant’s disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991); MPEP § 2143. The Examiner must avoid hindsight. *In re Bond*, 910 F.2d 831, 834, 15 USPQ2d 1566, 1568 (Fed. Cir. 1990).

The Examiner rejected claims 47, 61, 65, and 69 based on Ikeda. Applicant respectfully traverses the single reference rejection under 35 U.S.C. § 103 since not all of the recited elements of the claims are found Ikeda. Since all the elements of the claim are not found in the reference, Applicant assumes that the Examiner is taking official notice of the missing elements. Applicant respectfully objects to the taking of official notice with a single reference obviousness rejection

and, pursuant to M.P.E.P. § 2144.03, Applicant respectfully traverses the assertion of Official Notice and requests that the Examiner cite references in support of this position.

Similarly regarding claims 73, 78, and 82, Applicant respectfully requests a reference, pursuant to M.P.E.P. Section 2144.03, which describes Applicant's inclusion of zinc as claimed in order to support the Examiner's position.

Further, Applicant again respectfully submits that, Xu does not cure the deficiencies of Ikeda as described above. Because the cited references, either alone or in combination, do not show every element of Applicant's independent claims, a 35 USC § 103(a) rejection is not supported by the references. Reconsideration and withdrawal of the rejection is respectfully requested with respect to Applicant's claims 47, 61, 65, 69, 73, 78, and 82.

Conclusion

Applicant respectfully submits that the claims are in condition for allowance and notification to that effect is earnestly requested. The Examiner is invited to telephone Applicant's attorney (612- 373- 6944) to facilitate prosecution of this application.

If necessary, please charge any additional fees or credit overpayment to Deposit Account No. 19-0743.

Respectfully submitted,

GURTEJ SINGH SANDHU ET AL.

By their Representatives,

SCHWEGMAN, LUNDBERG, WOESSNER & KLUTH, P.A.

P.O. Box 2938

Minneapolis, MN 55402

(612) 373-6944

Date

8-30-02

By

David C. Peterson

Reg. No. 47,857

CERTIFICATE UNDER 37 CFR 1.8: The undersigned hereby certifies that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail, in an envelope addressed to: Commissioner of Patents, Washington, D.C. 20231, on this 30th day of August, 2002.

Name

Amy Moriarty

Signature

Amy Moriarty